

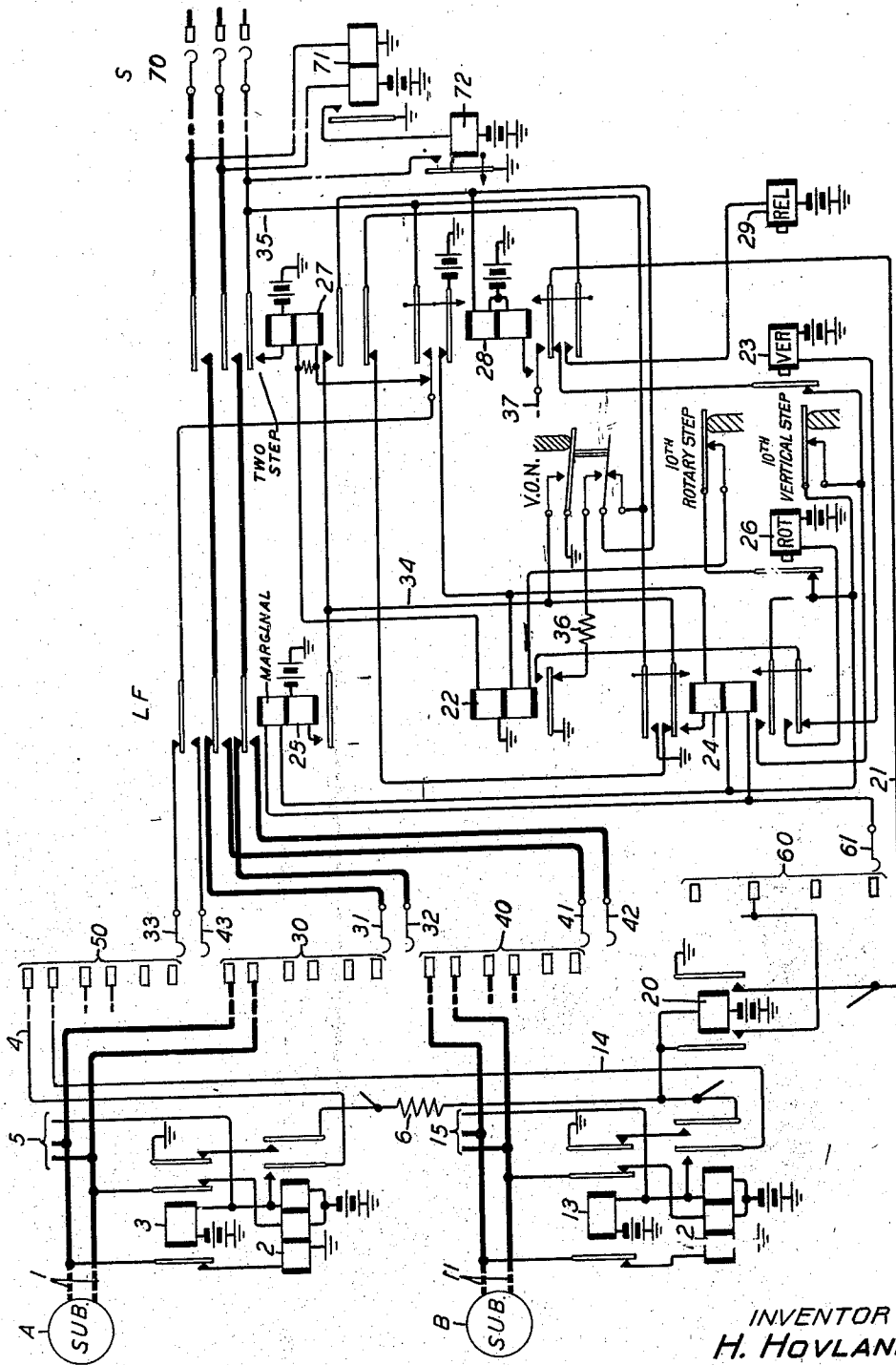
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TELEPHONE EXCHANGE SYSTEM

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TELEPHONE EXCHANGE SYSTEM

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This invention relates to telephone systems and more particularly to systems in which automatic switches are employed in extending connections.

5 The object of the invention is to improve such systems by providing a more efficient and economical arrangement for automatically extending a calling line to a first selector switch.

10 Heretofore line-finder switches have been equipped with two sets of brushes, each set having access to a 100-point bank, that is, a bank having 10 levels and 10 sets of terminals per level. In some cases one group relay has been provided for each level, both sets of brushes being effective to hunt for the calling line until the calling line has been found. In other cases two group relays have been provided for each level, one for the lines connected to terminals in the one bank and the other for the lines connected to terminals in the other bank; the set of brushes which has access to the calling line are rendered effective for seeking the calling line, to the exclusion of the other set of brushes, as soon as both sets have been advanced to the level on which the terminals of the calling line are located, thus obviating the necessity for testing the terminals in both banks. Such an arrangement shortens the time for finding the calling line or permits larger line groups without increasing the time for finding the calling line.

35 One feature of this invention is a line-finder switch having two banks and two sets of brushes but only one group relay per level. That set of brushes which has access to a particular calling line is rendered effective for seeking the calling line, to the exclusion of the other set of brushes, as soon as the brushes have been advanced to the level on which the terminals of the calling line are located.

45 The invention is illustrated in a system using step-by-step line-finder switches each having a capacity of 200 lines; but the invention is applicable to any finder switch equipped with two sets of brushes and banks.

50 The drawing discloses a line-finder switch embodying the features of this invention and also illustrates in diagrammatic manner a

first selector switch with which the line-finder is permanently associated.

Referring to the drawing, A and B represent subscriber's stations connected, by the lines 1 and 11 respectively, to terminals in the banks of line-finder switches of which one only is shown. This line-finder, LF, has two sets of brushes mounted on one shaft each set having access to the bank terminals of a group of 100 lines. The switch includes a vertical stepping magnet 23 for advancing the shaft and brushes in vertical movement, a rotary stepping magnet 26 for advancing the brushes in a rotary movement, and a release magnet 29 for returning the shaft and brushes to their normal position.

The lines of one group, including line 1, are connected to terminals in the bank 30 to which the brushes 31 and 32 have access; and the lines of the other group, including the line 11, are connected to terminals in the bank 40 to which the brushes 41 and 42 have access. The terminals of banks 30 and 40 are arranged in ten levels, there being 10 sets of terminals in each level. The test or sleeve conductors for both groups of lines connect to terminals in the bank 50 to which the brushes 33 and 43 have access. The terminals of bank 50 are likewise arranged in 10 levels of 10 sets of terminals per level but the upper terminal of each set is associated with the similarly located set of line terminals in the bank 30; and the lower terminal of each set is associated with the similarly located set of line terminals in bank 40. Lines 1 and 11 and the associated line and cut-off relays 2, 3, 12 and 13 are connected over conductors 5 and 15 to terminals in the banks of connector switches provided for completing incoming calls in the usual manner.

90 The switch is further equipped with a vertical commutator 60 having 10 segments, one for each level of terminals in the banks 30 and 40. Attached to the shaft is a commutator brush 61 arranged to make contact successively with the commutator segments as the shaft is stepped up from one level to the next. Whenever a call is originated over a line to which the line-finder has access, a ground is connected to the commutator seg- 100

ment corresponding to the level in which the terminals of this line are located so as to cause the line-finder to stop when its shaft and brushes have been stepped up to this level. This ground connection is controlled by a single group relay (such as relay 20) for all of the lines connected to the terminals of that level of both banks 30 and 40. This same group relay is used in starting an idle finder in search for the terminals of the calling line.

Since but one of the two sets of brushes has access to the terminals of a particular line, the required set of brushes must be rendered effective, to the exclusion of the other set, at or before the finding of the terminals of the calling line. To this end the aforementioned group relay is arranged to connect the corresponding commutator segment directly to ground if the calling line is connected to terminals in bank 40, and to connect this segment to ground through a resistance (such as the resistance 6) if the calling line is connected to terminals in the bank 30. Whether or not this resistance is included in the circuit through the commutator brush 61, when the shaft has been stepped up to the level of the terminals of the calling line, controls a brush switching relay 25 so that the proper set of brushes will be effective to find the terminals of the calling line. When the selected set of brushes has been advanced by the operation of the rotary stepping magnet into engagement with the terminals of the calling line the cut-through relay 27 operates to extend the connection from the line-finder brushes to the associated selector S.

To describe the operation in detail assume that the subscriber at station A initiates a call. When the receiver is removed from the receiver hook at station A, the line relay 2 operates in an obvious circuit. Relay 2 closes a circuit, for operating group relay 20, from ground at the back contacts of the cut-off relay 3, through the outer front contact of line relay 2, resistance 6, and through the winding of group relay 20 to battery. Line relay 2 also connects its holding winding, in parallel with the winding of the cut-off relay 3, through the inner front contact of line relay 2, over conductor 4, to the sleeve terminal of line 1 in bank 50.

In operating, group relay 20 closes a circuit from ground through its right-hand front contacts, over conductor 21 through the lower back contacts of relay 28, back contact of vertical magnet 23, normally closed contacts of the "10th vertical step" springs, back contact of the rotary magnet 26, normally closed contacts of the "10th rotary step" springs, lower winding of relay 22, and through the upper back contact of relay 28 to battery. The closing of this circuit is effective to operate the interrupter relay 22. Relay 22 closes a circuit from ground through its front con-

tacts, the lower back contact of relay 24 and through the winding of vertical magnet 23 to battery. The vertical magnet 23 is thereby operated to advance the shaft and brushes of line finder LF up to the first level. The vertical off-normal springs VON are actuated when the shaft is stepped out of its normal position thereby connecting ground to conductor 34. The operation of magnet 23 also opens the circuit through the lower winding of relay 22, thereby causing the release of relay 22. The release of relay 22 opens the circuit through the winding of vertical magnet 23, thereby causing the release of magnet 23. The release of magnet 23 again closes the circuit through the lower winding of relay 22. Thus interrupter relay 22 and vertical stepping magnet 23 alternately operate and release to advance the shaft and brushes of line-finder LF until the level of the calling line is reached.

As shown in the drawing, line 1 is connected to terminals in the third level of bank 30 and the aforementioned operation of group relay 20 was, therefore, effective to connect ground through the back contact of cut-off relay 3, the outer front contact of line relay 2, resistance 6, and through the left-hand front contact of relay 20, to the third segment of commutator 60. When the shaft and brushes have been advanced to the third level, a circuit is closed from this ground potential on the third segment of commutator 60, through commutator brush 61, lower winding of relay 24 in parallel with the upper winding of relay 25, back contact of rotary magnet 26, normally closed contacts of the "10th rotary step" springs, lower winding of relay 22, and through the upper back contact of relay 28 to battery. Relay 24 operates but relay 25 is marginal and does not operate at this time. Relay 22 is held operated in this circuit even through the vertical magnet 23 has opened its back contact. Relay 24 closes a locking circuit which may be traced from battery through the upper back contact of relay 28, the upper winding and inner front contact of relay 24, and through the upper contacts of the VON springs to ground. Relay 24 opens the circuit through the winding of vertical magnet 23 thereby causing the release of magnet 23; but relay 24 is slow in operating so as to be sure that magnet 23 is fully operated before relay 24 opens the circuit through the winding of magnet 23. The release of magnet 23 again closes the circuit through the lower winding of relay 22, over conductor 21, to the ground at group relay 20. In case the calling line is connected to terminals on the tenth level, the circuit through the winding of relay 22 is maintained through the inner lower front contacts of relay 24, instead of through the "10th vertical step" springs. Relay 24 also closes a circuit for operating the rotary mag-

net 26; this circuit may be traced from battery through the winding of magnet 26, the outer lower front contact of relay 24, to ground at the front contact of relay 22.

5 The operation of the rotary magnet advances both sets of brushes into engagement with the first set of terminals in the previously selected level of both banks 30 and 40. Since the marginal brush switching relay 25 was not
10 operated, brushes 31, 32 and 33 are effective on the call in question to the exclusion of brushes 41, 42 and 43.

If the calling line is connected to the first set of terminals in the selected level, the
15 sleeve brush 33 finds a distinguishing potential on the sleeve terminal of this set which is effective to operate cut-through relay 27 and to prevent further advance of the brushes by holding relay 22 operated. If the
20 calling line is not connected to the first set of terminals in the selected level, the sleeve terminal tests idle or busy, depending upon whether the line associated therewith is idle or busy; but in either case the cut-through
25 relay 27 is not operated and the interrupter relay 22 is released by the operation of the rotary magnet. The release of relay 22, due to the operation of magnet 26, opens the circuit through the winding of magnet 26. The
30 release of magnet 26 again closes the circuit for operating relay 22; and the reoperation of relay 22 closes the circuit for re-operating magnet 26. Thus the interrupter relay 22 and the rotary stepping magnet 26 alternately
35 operate and release to advance the brushes successively from one set of terminals to the next until the terminals of the calling line are reached.

When brush 33 makes contact with the
40 sleeve terminal of the calling line, relay 22 is held operated to prevent further advance of the brushes; the circuit for holding relay 22 may be traced from battery through the right-hand winding of line relay 2 in parallel
45 with the winding of cut-off relay 3, inner front contact of relay 2, over conductor 4, sleeve terminal and brush 33, outer upper back contact of relay 25, upper back contact of relay 28, lower winding of relay 27, and through the upper winding of
50 relay 22 to ground. This circuit is also effective to operate the cut-off relay 3, to partially operate the cut-through relay 27, and to hold the line relay 2 operated. Relay 27 is energized sufficiently to operate its inner upper
55 front contact and thus close a circuit from battery through its upper winding to ground at the outer upper front contact of relay 24; the energization of the upper winding of relay 27 causes the complete operation of this relay.

The aforementioned operation of cut-off relay 3 disconnects the conductors of line 1 from the windings of line relay 2, but relay 2
60 does not release since its holding winding is

energized in parallel with the winding of the cut-off relay. The operation of relay 3 also opens the circuit through the winding of group relay 20, and the release of relay 20
70 disconnects the ground from start conductor 21. With brush 33 in contact with the sleeve terminal of line 1 the potential of the sleeve terminals of this line in the banks of all line-finder and connector switches having access thereto is such as to indicate that the line is
75 busy and prevent any other hunting line-finder or any connector switch from stopping on the terminals of this line.

The complete operation of relay 27 extends the connection from line 1 through its upper
80 front contacts to the windings of line relay 71 of selector S. Relay 71 operates, thereby causing the operation of the slow-to-release relay 72. Relay 72 connects a holding ground to the sleeve conductor 35 so as to hold relay
85 27 through its upper winding independently of the ground at the outer upper front contact of relay 24. Relay 27 also closes a circuit for operating relay 28; this circuit may be traced from battery through the upper
90 winding of relay 28, the inner lower front contact of relay 27, conductor 34, to ground at the upper front contact of the VON springs. Relay 28 opens the circuit through the upper winding of relay 22 and opens the
95 circuit through the lower winding of relay 27. Relay 22 releases since the circuit through its lower winding was previously opened by the operation of rotary magnet 26. The release of relay 22 causes the release of
100 magnet 26.

With relay 28 operated line relay 2 and cut-off relay 3 are held operated by the ground on sleeve conductor 35. The operation of relay
105 28 also opens the circuit through the upper winding of relay 24; and relay 24 releases since the circuit through its lower winding was opened at commutator brush 61 when the multiple brushes were rotated into engagement with the first set of terminals in the selected level. With relay 28 operated, the
110 start conductor 21 is extended, through the middle lower front contact of relay 28, to conductor 37 which leads to the next line finder in the group of line-finders having access to the same lines as line-finder LF.
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No further operation takes place in the line-finder circuit until the connection is released by the calling subscriber at which time the selectors and connector through which
120 the connection was completed are restored to normal, and the holding ground is disconnected from sleeve conductor 35. Line relay 2 and cut-off relay 3 are thereby released so that another call may be initiated, or an incoming call received, at station A. Relay 27
125 also releases when the holding ground is disconnected from sleeve conductor 35 thereby disconnecting the upper winding of relay 28 from the ground at the upper front contact
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of the VON springs; but relay 28 does not release at this time since this winding is also connected through the lower front contact of the VON springs and through resistance 36 to ground at the back contact of relay 22. The release of relay 27 closes a circuit for operating release magnet 29; this circuit may be traced from battery through the winding of magnet 29, outer lower front contact of relay 28, outer lower back contact of relay 27, inner upper back contact of relay 24, to ground at the upper front contact of the VON springs. The operation of magnet 29 causes the shaft and brushes to restore to normal. With the VON springs thus restored to normal position, ground is disconnected from conductor 34, thereby releasing magnet 29. Relay 28 now releases unless it is held operated through its lower winding and inner front contacts to ground on starting conductor 21; thus relay 28 cannot release if starting conductor 21 is grounded due to the origination of another call until the calling line has been found by some other line-finder in the group. The release of relay 28 disconnects starting conductor 21 from conductor 37 and from the lower winding of relay 28. The line-finder LF is now ready for use on another call.

If a call is originated over a line connected to terminals in the bank 40, it is necessary that brush switching relay 25 be operated. Assuming a call to have been originated at station B, the operation of group relay 20 connects the third commutator segment through the left-hand front contact of relay 20, through the outer front contact of line relay 12, to ground at the back contact of cut-off relay 13. When commutator brush 61 makes contact with this commutator segment, the current through the upper winding of relay 25 operates this relay so as to render brushes 41, 42 and 43 effective to the exclusion of brushes 31, 32 and 33. Relay 25 locks through its lower winding and front contact, over conductor 34, to ground at the upper front contact of the VON springs. With this exception, the operation of line-finder LF is the same as when the call originated over a line connected to terminals located in bank 30. When the line-finder is restored to normal, relay 25 is released.

In case the shaft and brushes are stepped up to the 10th level and there is no ground potential on the tenth commutator segment, relay 24 does not operate. The circuit through the lower winding of relay 22 is opened at the "10th vertical step" springs and relay 22 releases, thereby causing the immediate operation of relay 28. Relay 28 transverse the starting conductor 21 to the next line-finder in the group; so that there will be no delay in starting a finder switch in search for the next calling line, in case another call is originated before the switch LF

is restored to normal. Since relays 24 and 27 have not been operated, the circuit for operating release magnet 29 is closed and the switch is immediately restored to normal.

In case the shaft and brushes are stepped around to the tenth set of terminals in any level and the line connected thereto is not the calling line, the upper winding of relay 22 is not energized; and, since the circuit through its lower winding has been opened at the "10th rotary step" springs, relay 22 releases. The release of relay 22 causes the operation of relay 28; and relay 28 closes the circuit for operating release magnet 29. The line-finder is, therefore, immediately restored to normal.

What is claimed is:

1. In combination, an automatic switch comprising a plurality of terminal banks, a set of brushes for each bank, groups of lines, each group comprising a plurality of sub-groups one for each of said banks, group relays one for each of said groups of lines, means effective upon the operation of one of said group relays for advancing said sets of brushes, in a primary movement to select the corresponding sub-groups, a circuit for stopping said primary movement and for selecting one of said brush sets, and means for advancing said brush sets in a secondary movement into engagement with the terminals of the selected sub-groups.

2. In combination, an automatic switch comprising a plurality of terminal banks, a set of brushes for each bank, groups of lines each group comprising a plurality of sub-groups one for each of said banks, a group relay for each of said groups of lines, means effective upon the operation of one of said group relays for advancing said brush sets in a primary movement to select the corresponding sub-groups, a circuit controlled by said one of said group relays for stopping said primary movement and for selecting one of said brush sets, and means for advancing said brush sets in a secondary movement into engagement with the terminals of the selected sub-groups.

3. In combination, a two-motion automatic switch having two sets of brushes and two banks of terminals, groups of lines, each group comprising two sub-groups, the lines of one sub-group being connected to terminals in one of said banks and the lines of the other sub-group being connected to the correspondingly located terminals in the other of said banks, group relays one for each of said groups of lines, means effective upon the operation of one of said group relays for advancing the brushes in a primary movement to select the corresponding sub-groups, a circuit effective to stop said brushes upon reaching said corresponding sub-groups and effective to select one of said brush sets, and means for advancing said brush sets in a secondary

movement into engagement with the terminals of the selected sub-groups.

4. In a telephone system, a two-motion automatic switch having two sets of brushes and two banks of terminals, the terminals in each bank being arranged in groups, groups of lines one for each of said groups of terminals, group relays one for each group of terminals in the one of said banks and for the correspondingly located group of terminals in the other of said banks, means including one of said group relays effective upon the origination of a call over one of said lines for starting the operation of said switch, means for advancing the brushes of said switch in a primary movement to the two correspondingly located groups of terminals which include the terminals to which the calling line is connected, means for advancing said brushes in a secondary movement into contact with the terminals of said calling line, and switching means for controlling the said two sets of brushes so that the set having access to the terminals of the calling line is effective during said secondary movement to the exclusion of the set which does not have access to these terminals.

5. In combination, an automatic switch comprising two sets of brushes and two terminal banks, the terminals in each bank being arranged in ten levels, groups of lines, each group comprising two sub-groups, the lines of one sub-group being connected to terminals in one level of one of said banks and the lines of the other sub-group being connected to terminals in the same level of the other of said banks, a group relay for each of said groups of lines, means effective upon the operation of one of said group relays for advancing the brushes in a primary movement to the corresponding level, a circuit controlled by said one of said group relays for stopping the primary movement upon reaching said corresponding level, a marginal relay in said circuit for selecting a desired one of said brush sets, and means for driving said brush sets in a secondary movement into engagement with the terminals in the two sub-groups of the selected level.

6. In combination, an automatic switch having two terminal banks, a set of brushes for each bank, a relay for switching from one set of brushes to the other, groups of lines each group comprising a plurality of sub-groups one for each of said banks, a group relay for each of said groups of lines, means effective upon the operation of one of said group relays for advancing said brush sets in a primary movement to select the corresponding sub-groups, a circuit for stopping said primary movement and for operating said switching relay, and means for advancing said brush sets in a secondary movement into engagement with the terminals of the selected sub-groups.

7. In a telephone system, an automatic switch having two terminal banks, the terminals of each bank being arranged in ten levels, a set of brushes for each bank, a relay for switching from one set of brushes to the other, groups of lines each group comprising two sub-groups, the lines of one sub-group being connected to terminals in a particular level of one of said banks and the lines of the other sub-group being connected to terminals in the same level of the other of said banks, a group relay for each of said groups of lines, means effective upon the origination of a call over one of said lines for advancing said brush sets to the level of the calling line, a circuit for stopping the primary movement upon reaching the calling level, said circuit being effective to operate said switching relay if said calling line is connected to terminals in one of said banks and ineffective to operate said switching relay if said calling line is connected to terminals in the other of said banks, and means for advancing the brushes in a secondary movement into engagement with the terminals of the selected sub-groups.

In witness whereof, I hereunto subscribe my name this 28th day of July, 1930.

HENRY HOVLAND.

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